(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 101 203**
A2

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 83304195.7

(22) Date of filing: 19.07.83

(51) Int. Cl.^{3}: D 21 F 11/00
D 21 F 3/02

(30) Priority: 22.07.82 GB 8221235

(43) Date of publication of application: 22.02.84 Bulletin 84/8

(84) Designated Contracting States: AT BE CH DE FR GB IT LI NL SE

(71) Applicant: The Wiggins Teape Group Limited
P.O. Box 88 Gateway House Basing View
Basingstoke Hampshire RG21 2EE(GB)

(72) Inventor: Baker, Colin Francis
113 Vale Road
Chesham Buckinghamshire(GB)

(74) Representative: Carmichael, David Andrew Halliday et al,
G.F. REDFERN & CO. High Holborn House 52/54 High Holborn
London WC1V 6RL(GB)

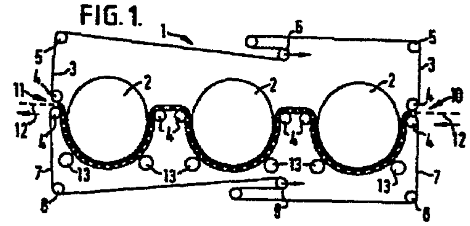
(54) Process for drying and consolidating a paper making web.

(57) A process for drying and consolidating a paper making web so as to enhance translucency in the resulting paper.

It is known to provide integral patterning by means of a dandy roll or by press marking or by embossing, but none of these known methods achieve controlled enhancement of translucency or tensile strength of paper.

The invention provides a process for producing paper having at least portions with enhanced translucency in which a paper making web formed at least in part of cellulosic fibres and having a water content of at least 20% is simultaneously supported and constrained against shrinkage without preventing the release of water or water vapour therefrom, maintained at a temperature sufficient to dry the web without causing thermal degradation as it dries, and subjected across at least portions thereof to a pressure sufficient to produce enhanced translucency and tensile strength in the corresponding portions of the dried paper. If the portions of enhanced translucency are interconnected to form a network this will confer enhanced tensile strength on the structure of the paper.

FIG. 1.



EP 0 101 203 A2

0101203
3401

PROCESS FOR DRYING AND CONSOLIDATING A PAPER MAKING WEB

This invention relates to a process for drying and consolidating a paper making web so as to enhance translucency in the resulting paper. The process may be applied to the whole paper web or in selected zones so as to integrally pattern the web. If applied to the whole web or to an interconnected network of zones across the web, the process also serves to enhance the tensile strength of the web.

In this specification, "integral patterning" refers to patterning resulting from changes made in the configuration of the fibrous structure of the paper as distinct from those resulting from conversion operations such as printing, impregnation or coating after the paper has been finally formed.

The degree of light transmission through paper is dependent upon the surface area of the fibre to air interfaces within the sheet. If the surface area is high, a substantial proportion of light incident upon the sheet will be scattered at these interfaces and the opacity of the paper will be high.

In papers in which enhanced translucency is required, this is normally achieved by the use of highly wet beaten fibres in the manufacture of the paper. Such treatment increases both the suppleness and the fibrillation of the fibres in such a way that the degree of interfibre contact and bonding withn the paper web is substantially increased. Because of the increased bonding and the consequent reduction in the exposed surface area of the fibres, both the translucency and the tensile strength are increased. Such fibres are used for example in the manufacture of glassine and tracing papers.

However, the production of highly wet beaten fibres is costly in both time and energy and this is reflected in the

cost of these papers. In addition, the paper making process conventionally used for the manufacture of glassine and tracing papers does not facilitate the formation of selected zones in the sheet having enhanced translucency.

One known method of integral patterning consists of water marking which is effected as the paper sheet is being formed by drainage on the wire section of the Fourdrinier paper machine. Towards the end of the wire section, a "dandy" roll having an open surface framework is located so as to rotate in light contact with the web. This assists in compacting the upper surface and in improving the evenness of fibre distribution across the web. If it is desired to form a watermark, the dandy roll also carries block designs in the configuration of the desired watermark which stand proud of or are recessed from the surface of the roll. The web is thus subjected to a greater or lesser degree of compaction in the areas of those designs during rotation of the roll. As a result, redistribution of the fibres occurs, resulting in local variations in the thickness and grammage of the paper, although little variation in density occurs. In consequence, variations occur in the light transmission capability of the dried paper, resulting in the watermark effect.

Another form of integral patterning is that known as pressmarking. Here, a roll carrying raised profiles of the mark to be applied is arranged to bear lightly against the wet web during passage over a rubber backing roll and after the web has been lifted from the Fourdrinier wire. This technique produces slight indentations in the paper, causing corresponding slight local increases in density which affect the light transmissions. The resulting effect is visually similar to that of a watermark.

Watermarking and pressmarking are intended to produce marks which are essentially of a trademark charact r, but

which must only be perceivable as outlines in transmitted light. They are invariably applied in the production of plain paper for use as stationery and must be substantially unobtrusive in incident light if the paper is not to be rendered valueless for its intended purpose. Great care is therefore taken to avoid the production of noticeable surface irregularities in the production of such marks.

The process of embossing constitutes a third kind of integral patterning and can take two forms. In the first, a wet or rewetted paper web is passed through mating cold embossing rolls. In the second variant, and using a web manufactured at least partly from thermoplastic fibres, the web is preheated and passed through chilled embossing rolls, at least one of which carries the embossing profile, whereby it is reconsolidated. In both cases the embossing rolls rearrange the whole structure of the sheet to conform to the embossing profiles, but the resulting embossed sheet has minimal variations in density and grammage. Embossing may be carried out for decorative purposes or to suit the paper for some further intended purpose. For example, it may be formed into an oil filter in which the embossed pattern provides channels for the oil into or through the filter.

However none of the three known methods of integral patterning achieve controlled enhancement of the translucency or tensile strength of the paper.

The present invention is concerned with paper made at least in part of cellulosic fibres and utilizes c rtain characteristics of these fibres in the process of the invention. Cellulosic fibres are comprised partly of natural polymers in the form of cellulose and hemi-cellulose,

the glass transition temperatures of which are in the region of 300°C. But at such a temperature, and indeed at any temperature in excess of about 160°C, the fibre begins to thermally degrade. However, if such fibres are embodied in a fibrous web having a moisture content in excess of about 20%, plastic flow will occur in the cellulose and hemi-cellulose at temperatures below 160°C, provided that sufficient pressure is applied.

The invention therefore provides a process for producing paper having at least portions with enhanced translucency, in which a paper making web, formed at least in part of cellulosic fibres and having a water content of at least 20%, is simultaneously supported and constrained against shrinkage without preventing the release of water or water vapour therefrom, maintained at a temperature sufficient to dry the web without causing thermal degradation as it dries, and subjected, across at least portions thereof, to a pressure sufficient to produce enhanced translucency and tensile strength in the corresponding portions of the dried paper. If the portions of enhanced translucency are interconnected to form a network, this will confer enhanced tensile strength on the structure of the paper.

The drying temperature will preferably be kept at a level sufficient to convert the required proportion of the water content of the sheet to vapour as pressure is applied and is likely to be at least 80°C in order to achieve an acceptable rate of vaporisation. Although the maximum temperature can vary with the particular cellulosic fibres used, it is preferably kept below about 160°C to avoid thermal degradation of the web. In order to achieve a minimally satisfactory enhancement of translucency and tensile strength, a pressure of 4,000 kilo Pascals is preferably used for papers formed from 100% cellulosic fibres. If the paper has a synthetic thermoplastic content, lower pressures may be used.

In another aspect, the invention provides paper made according to the process above defined, in which at least portions thereof have enhanced translucency.

In a further aspect, the invention provides integrally patterned paper having areas selectively compacted to a condition of enhanced translucency and so as to leave residual zones having lower translucency. Preferably the selectively compacted areas are interconnected to form a network, which, by virtue of the compaction, confers greater tensile strength on the paper as a whole. By selecting suitable furnishes, the residual zones form islets which are permeable to gases or liquids. Such paper is capable of functioning as a filter medium and has a greater strength than a homogeneous filter paper formed from the same furnish without compaction.

The invention will now be further described with reference to the accompanying drawings, in which,

Figure 1 is a sectional side elevation of a first paper drying assembly for carrying out the process of the invention,

Figure 2 is a sectional side elevation of a second paper drying assembly for carrying out the process of the invention,

Figure 3 is a plan view of part of a transparentized sheet according to the invention,

Figure 4 is a sectional detail on the line IV - IV of Figure 3,

Figure 5 is a plan view of part of a first integrally patterned sheet according to the invention,

Figure 6 is a sectional detail on the line VI - VI of Figure 5,

Figure 7 is a plan view of part of a second integrally

patterned sheet according to the invention,

Figure 8 is a sectional detail on the line VIII - VIII of Figure 7,

Figure 9 is a plan view of part of a third integrally patterned sheet according to the invention, and

Figure 10 is a sectional detail on the line X - X of Figure 9.

Referring first to Figure 1, a paper drying assembly 1 is shown having three rotatable drying drums 2. The drums 2 may be heated for example, by the introduction internally of saturated steam as in a conventional paper dryer.

A permeable endless and substantially incompressible belt 3 is guided and held in close contact with the drying drums 2 by guide rolls 4. The return run of the belt 3 is determined by return guide rolls 5 and a tensioning device 6 located above the drying drums 2.

A second permeable endless and substantially incompressible belt 7 is also guided by the guide rolls 4 so as to overlie the belt 3 as it passes around the drying drums 2. The return run of the belt 7 is determined by return guide rolls 8 and a tensioning device 9 located below the drying drums 2.

By providing independent return runs for the belts 3 and 7, entry and exit points 10 and 11 are provided for a paper web 12 where the belts respectively marry and separate.

For each drying drum 2, a pair of pressure rolls 13 are provided, so as to nip the belts 3 and 7 , together with the paper web 12, against the drums 2.

In use, the paper web 12 is fed and trapped b tween the belts 3 and 7 at the entry point 10 to the assembly. As the drying drums 2 rotate, the pressure rolls 13 are adjusted to apply a nip pressure on the belts and paper web against the drying drums 2 of at least 4,000 kilo Pascals. At the same time, the temperature and speed of rotation of the drying drums 2 are controlled so as to maintain a temperature in the paper web 12 of less than about 160^{o}C, but sufficient to reduce the moisture content of the web to the desired level as it leaves the exit point 11.

Referring now to Figure 2, a paper drying assembly 20 is shown, having a single rotatable drying drum 21 having dimensions of the order of those of an MG (Yankee) cylinder of an MG paper machine. The drying drum 20 may be heated by the introduction internally of saturated steam, in the manner conventional with MG cylinders.

A permeable, endless and substantially incompressible belt 22 is guided into and out of engagement with the drying drum 21 by guide rolls 23. The return run of the belt 23 is determined by guide rolls 24 and a tensioning device 25.

A paper web 26 to be dried is fed along a conveyor element 27, which may be the felt of a wet press, and transferred at the point 28 to the belt 22. The belt 22 then carries the paper web 26 into engagement with the surface of the drum 22 and maintains this engagement until separation is effected as they pass around the second guide roll 23 at the point 30.

Around the drying drum 21, a number of satellite press rolls 29 are located so as to nip the belt 22 and the paper web 26 against the surface of the drying drum as the drum rotates.

The press rolls 29 maintain a nip pressure equivalent to at least 4,000 kilo Pascals on the belt 22 and paper web 26 as the drum 21 rotates. At the same time, the temperature and

speed of rotation of the drum 21 are controlled so as to maintain a temperature in the paper web 26 of less than about 160°C, but sufficient to reduce the moisture content of the web to the desired level as it leaves the assembly at the point 30.

The belts 7 and 22 may typically be constructed of perforated metal sheet, woven from metal strands which are then sintered together or formed by sintering together randomly laid metal fibres. Preferably, the belts are made of corrosion resistant material such as stainless steel but suitably incompressible plastics materials may also be used. Preferred forms of belt construction are described in copending applications Nos. (Wiggins Teape Case Nos. W.78, W.79 and W.80)

In the assemblies of Figures 1 and 2, if it is desired to produce integral patterning in the paper webs 12 or 26, the belt 7 or 22 is provided with appropriate configurations so as to enhance the transparency in selected zones of the web as shown by way of example in Figures 5 to 10 which are described below.

Figures 3 and 4 show a paper sheet 30 which has been evenly compacted under temperature and pressure as above described, so as to reduce its thickness from that shown by a broken line 31 in Figure 4. This results in a substantial enhancement in both translucency and tensile strength.

Figures 5 and 6 show a paper sheet 35 which has been subjected to compaction against a paper drying "felt" of the kind sold under the Registered Trade Mark Scapalink. This material is form d from flattened interlinked coils made from hard plastics material strands which produce spaced linear compactions 36 in the paper sheet 35 and leave the r sidual areas 37 uncompact d.

Figures 7 and 8 show a paper sheet 40 which has been subject d to compaction against a belt formed as a woven metallic sheet having pronounced "knuckles". This has both compacted and pierced the sheet at the position 41 shown.

Figures 9 and 10 show a paper sheet 50 which has been subjected to compaction against a belt formed from a continuous metal sheet which has been perforated with large perforations of, for example, 10 mm in diameter. The portions 51 of the sheet which were not overlaid by the perforations are compacted so as to acquire enhanced transparency and tensile strength, whereas the residual portions 53 form islets of uncompacted material. By selecting suitable furnishes for the paper sheet, the material produced may perform effectively as a filter material.

CLAIMS:

1. A proc ss for producing paper having at least portions with enhanced translucency characterised in that a paper making web, formed at least in part of cellulosic fibres and having a water content of at least 20% is simultaneously supported and constrained against shrinkage without preventing the release of water or water vapour therefrom, maintained at a temperature sufficient to dry the web without causing thermal degradation as it dries, and subjected, across at least portions thereof, to a pressure sufficient to produce enhanced translucency and tensile strength in the corresponding portions of the dried paper.

2. A process as claimed in claim 1 characterised in that the portions of enhanced translucency are interconnected to form a network.

3. A process as claimed in claim 1 or claim 2 characterised in that the drying temperature is kept at a level sufficient to convert the required proportion of the water content of the sheet to vapour as pressure is applied.

4. A process as claimed in claim 3 characterised in that the drying temperature is at least 80%.

5. A process as claimed in claim 3 or claim 4 characterised in that the maximum drying temperature is kept below 160°C.

6. A process as claimed in any one of th preceding claims characterised in that a pressure of 4,000 kilo Pascals

is us d for papers formed from 100% cellulosic fibres.

7. Paper characterised in that it is made according to the process as claimed in any one of the preceding claims and that these portions thereof have enhanced translucency.

8. Integrally patterned paper characterised in that it has areas selectively compacted to a condition of enhanced translucency so as to leave residual zones having lower translucency.

9. Paper as claimed in claim 8 characterised in that the selectively compacted areas are interconnected to form a network which, by virtue of the compaction confers greater tensile strength on the paper as a whole.

FIG. 1.

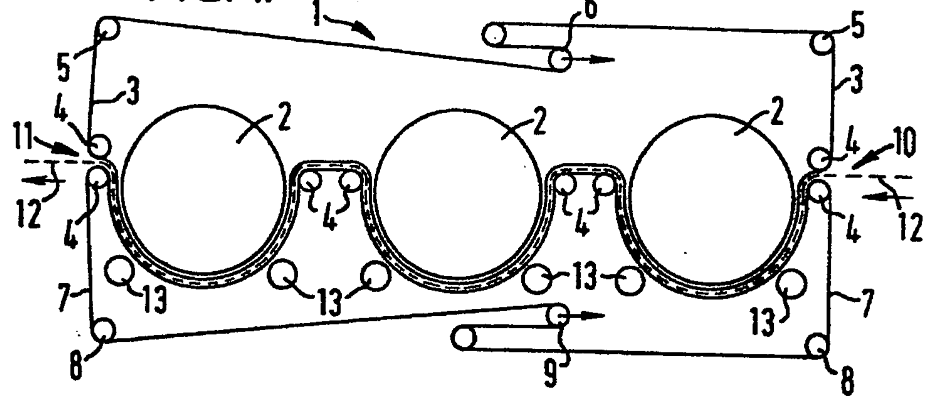
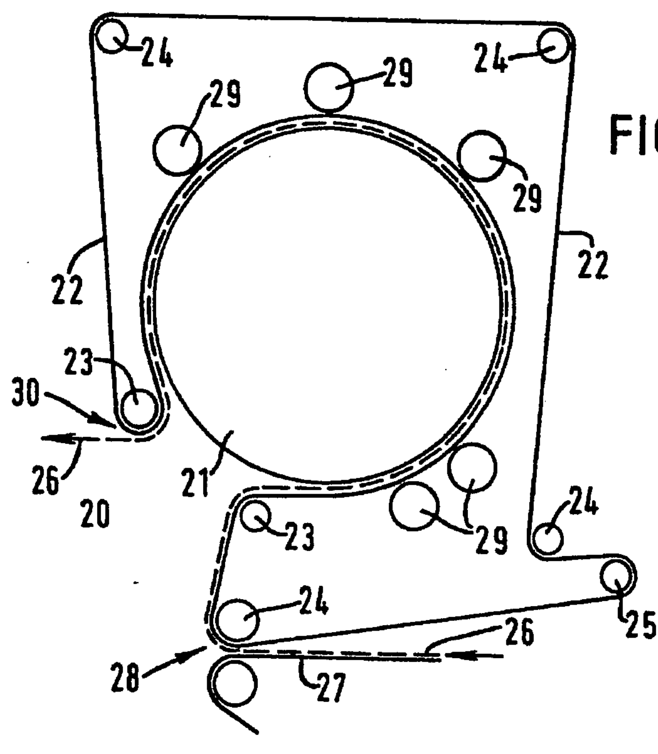


FIG. 2.



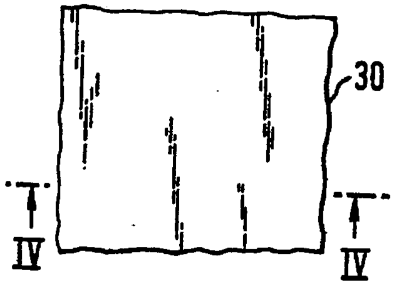


FIG. 3

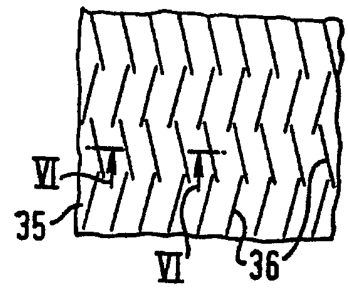


FIG. 5

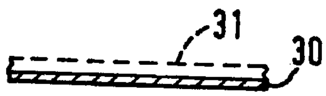


FIG. 4

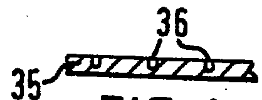


FIG. 6

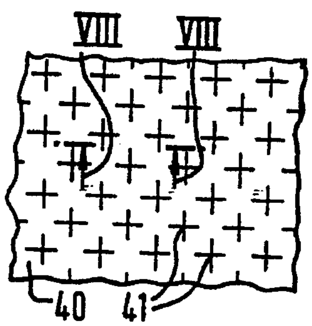


FIG. 7

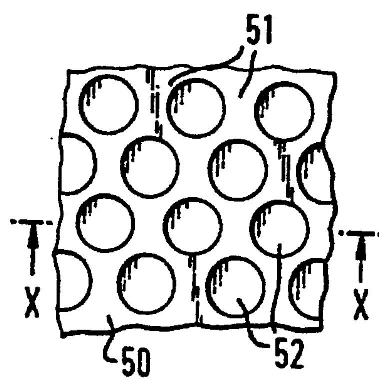


FIG. 9

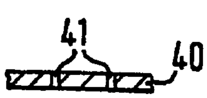


FIG. 8

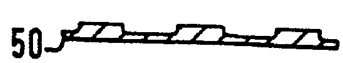


FIG. 10